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Data Quality Objectives for the Accelerated Retrieval Project for a Described Area within Pit 4

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Idaho Completion Project

Bechtel BWXT Idaho, LLC

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Idaho Falls, Idaho 83415

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ABSTRACT

This document states the purpose and scope and describes the methodology used to develop the data quality objectives. The data quality objectives process supports decision-making activities as they pertain to the Accelerated Retrieval Project in Waste Area Group 7 within the Idaho National Engineering and Environmental Laboratory. The data quality objectives are presented in an easy-to-read tabular format.

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ACRONYMS

AK	Acceptable Knowledge
ARAR	applicable or relevant and appropriate requirement
ARP	Accelerated Retrieval Project
CCP	Central Characterization Project
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
DEQ	Idaho Department of Environmental Quality
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FGE	fissile gram equivalent
FSP	field sampling plan
GGT	gas generation testing
HWD	hazardous waste determination
INEEL	Idaho National Engineering and Environmental Laboratory
NTCRA	non-time-critical removal action
OU	operable unit
PRD	program requirements document
PSQ	principal study question
QAPjP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RFP	Rocky Flats Plant
RI/FS	remedial investigation/feasibility study
ROD	record of decision

RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
TRU	transuranic
TWCP	TRU Waste Characterization Program
VOC	volatile organic compound
WAC	waste acceptance criteria
WAG	waste area group
WAP	Waste Analysis Plan
WIPP	Waste Isolation Pilot Plant

Data Quality Objectives for the Accelerated Retrieval Project for a Described Area within Pit 4

1. INTRODUCTION

The U.S. Department of Energy (DOE) Idaho Operations Office, with agreement from the U.S. Environmental Protection Agency (EPA) and Idaho Department of Environmental Quality (DEQ), has selected a designated portion of Pit 4 for implementation of a non-time-critical removal action (NTCRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at the Idaho National Engineering and Environmental Laboratory (INEEL). The project is referred to as the Accelerated Retrieval Project (ARP).

The DOE has determined that the removal action shall, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action. Specifically, the proposed removal action, in addition to addressing a material portion of the hazardous substances in the Subsurface Disposal Area (SDA), will provide characterization, and technical and cost information from full-scale waste retrieval activities that will support the remedial investigation/feasibility study (RI/FS) for operable unit (OU) 7-13/14. It also will establish process details for certification and transfer of formerly buried transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP) in New Mexico.

1.1 Purpose

This document presents project data quality objectives (DQOs) for the ARP and describes the process by which these objectives were developed. This information is contained in tabular form in Table 1, which has been placed at the end of this document for ease of reference.

Data quality objectives are qualitative and quantitative statements that define the type, quality, and quantity of data necessary to support making defensible risk management decisions. The DQOs are used to develop an effective sampling plan that satisfies project data needs and avoids collecting data inconsequential to making decisions.

The DQOs in this document provided a basis for developing two field sampling plans (FSPs) and implementing procedures. One FSP covers characterization of material that stays in the pit and potentially mobile contaminants of concern (COCs) in underburden soil. A second FSP to characterize TRU waste for ultimate disposition at WIPP will be implemented under Central Characterization Project (CCP) WIPP certification authority for confirmation of Acceptable Knowledge (AK) and assignment of Resource Conservation and Recovery Act (RCRA) hazardous waste numbers.

1.2 Scope

Project DQOs include the following:

- General project data objectives including public and worker safety
- Characterization of TRU waste for disposal at WIPP
- Waste zone material characterization objectives for safe and compliant storage and final disposition of waste zone materials
- Provide technical information to support OU 7-13/14 RI/FS

- Characterization objectives for certain contaminants in the underburden.

Minimum DQOs and the associated characterization approach for the project also are shown in Table 1.

1.3 Background

The INEEL is a DOE facility, located 52 km (32 mi) west of Idaho Falls, Idaho, that occupies 2,305 km^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain. The Radioactive Waste Management Complex (RWMC) is located in the southwestern portion of the INEEL, as shown in Figure 1. The SDA is a 39-hectare (97-acre) area located within the RWMC. The SDA consists of 20 pits, 58 trenches, 21 soil vault rows, Pad A, and the Acid Pit, where waste disposal activities occurred. Pit 4 Area is located in about the center of the RWMC SDA. The described area for retrieval is located in the eastern half of Pit 4.

The selection of the described area within Pit 4 (see Figure 2) as the specific retrieval area for this project was based on an evaluation of shipping and burial records of containerized radioactive materials and sludge from the DOE Rocky Flats Plant (RFP) and radioactive waste generated at the INEEL. From these records, several 1/2-acre areas within the SDA that contain relatively large amounts of TRU or other contaminated waste were targeted.

The objective of the NTCRA is to perform a targeted retrieval of certain Rocky Flats waste streams that contain significant concentrations of the COCs identified in the OU 7-13/14 risk assessment (Holdren et al 2002). To achieve this objective, the NTCRA will focus on visual identification and removal of the following Rocky Flats Plant waste streams: Series 741 and 743 sludge, graphite, filters, and roaster oxide waste. The overall remediation of waste area group (WAG) 7 is being evaluated through a CERCLA RI/FS under OU 7-13/14. Ultimately the RI/FS will lead to risk management decisions and selection of a final comprehensive remedial approach through development of a CERCLA Record of Decision (ROD) and follow-on remedial design and activities.

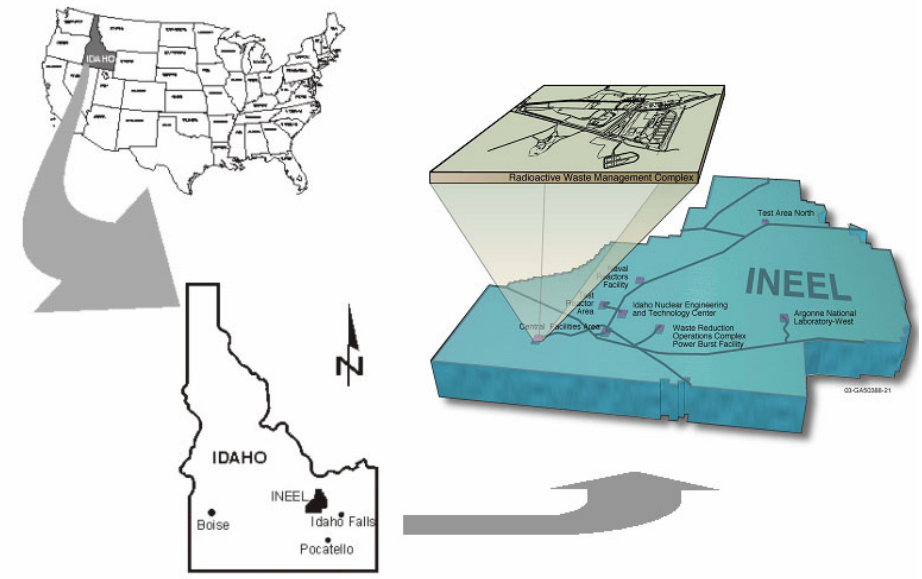

Figure 1. Map showing the location of the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory.

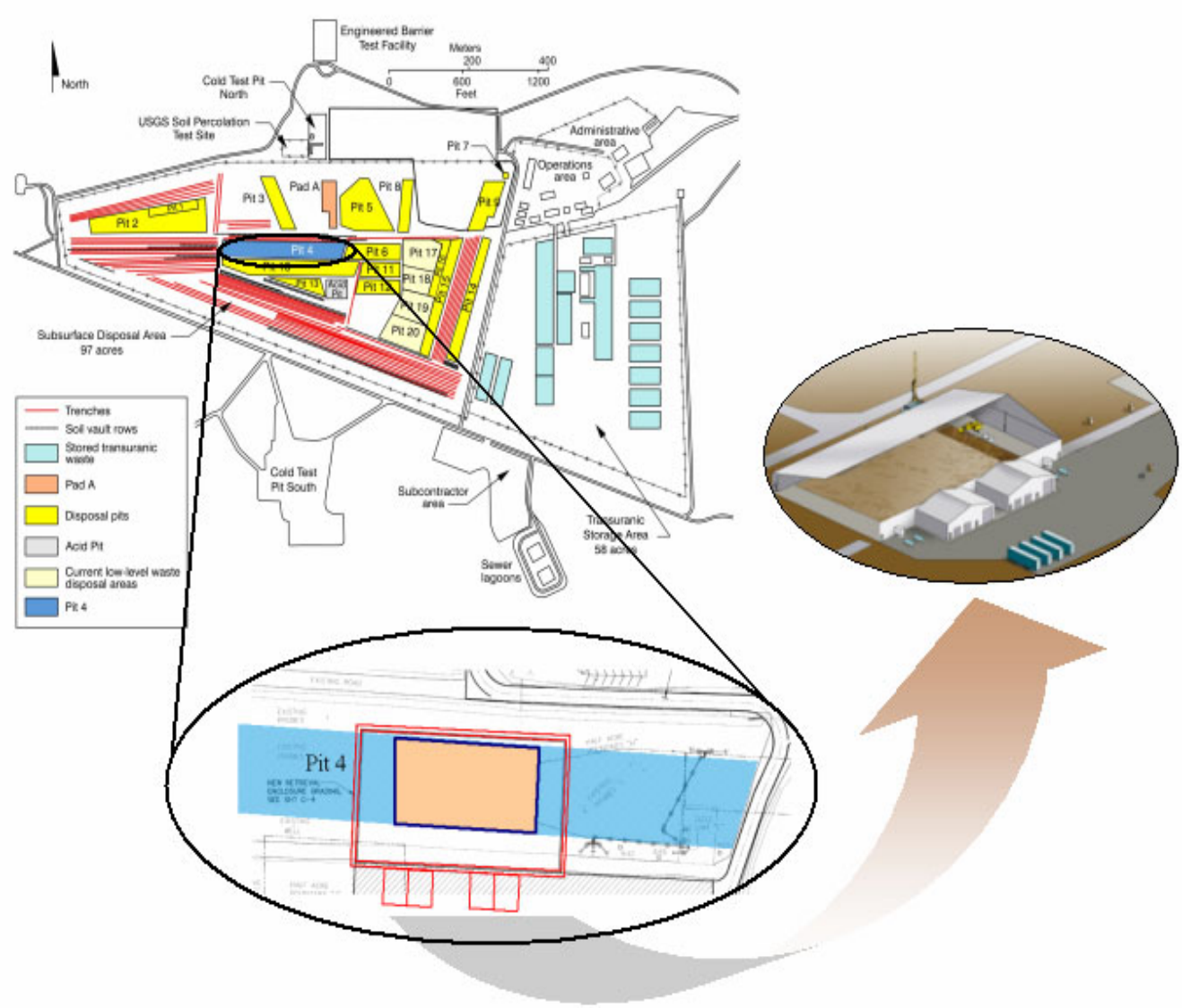

Figure 2. Map of the Subsurface Disposal Area showing location of the described area within Pit 4.

2. DATA QUALITY OBJECTIVES FOR THE ACCELERATED RETRIEVAL PROJECT

By developing DQOs, the Accelerated Retrieval Project is able to make cost-effective data collection decisions to meet specific needs and comply with the U.S. Environmental Protection Agency (EPA) document *Guidance for the Data Quality Objectives Process* (EPA 2000) and EPA Order 5360.1 A2, "Policy and Program Requirements for the Mandatory Agency-Wide Quality System, U.S. Environmental Protection Agency." This order requires all EPA organizations (and organizations with additional agreements with EPA) to follow a systematic planning process to develop acceptance or performance criteria for the collection, evaluation, or use of environmental data.

2.1 Data Quality Objective Process

DQOs are discussed in context of the DQO process as defined by EPA guidance in *Guidance for the Data Quality Objectives Process* (EPA 2000). This process was developed by EPA to ensure the type, quantity, and quality of data used in decision-making is appropriate for the intended application. The DQO process is best used when selection has to be made between alternative conditions (e.g., compliance or non-compliance with a standard). The DQO process includes seven steps, each of which has specific outputs. DQOs are qualitative and quantitative statements that:

- **State the Problem:** Clarify the nature of the problem or study objective.
- **Identify the decision:** Specify what decisions are to be made to address the objective.
- **Identify Inputs to the Decision:** Define the most appropriate type of data to collect.
- **Define the Study Boundaries:** Determine the most appropriate conditions from which to collect the data.
- **Develop a Decision Rule:** Define how the data will be used to choose among alternative actions.
- **Specify Limits on Decision Errors:** Specify tolerable limits on decision errors that will be used as a basis for establishing the quantity and quality of data needed for decision-making.
- **Optimize the Design:** Develop a data collection design based on the criteria of the first six steps.

The data gaps, study boundaries, and decision inputs and rules are discussed in the following sections. Data collection activities and needs for the project are also discussed.

2.2 Targeted Waste

The ARP provides a method for performing a CERCLA NTCRA to retrieve and manage the Series 741 and 743 sludge, filters graphite, and uranium oxide material buried in the designated area of Pit 4 at the RWMC.[a] The process for targeted waste is described as follows:

a. The steps described relative to WIPP characterization are not intended to bind operations to specific steps; rather, they provide an overview of the process.

- Excavate the waste zone material and separate targeted waste (i.e., filters, sludges, graphite, uranium) from nontargeted waste.
- Leave nontargeted materials in the excavation area.
- Perform WIPP-certified visual examination and package targeted waste in containers (e.g., 55-gal drums)
- Randomly sample the excavation site for RCRA considerations per Waste Isolation Pilot Plant (WIPP) Waste Analysis Plan (NMED 2004) requirements
- Perform fissile assay of packaged waste to ensure criticality safety
- Place containers in interim storage pending CCP characterization and to meet drum aging criteria
- Assay and segregate the material into TRU (>100 nCi/g), non-TRU with volatile organic compounds (VOCs) or uranium, and non-TRU (less than or equal to 100 nCi/g) waste streams
- Provide final disposition for non-TRU waste including waste containing VOCs or uranium
- Perform headspace gas sampling on TRU-waste drums
- Perform gas generation testing (GGT) on TRU drums that failed headspace gas sampling and on test category waste
- Perform limited VOCs treatment of TRU drums that failed. (This is a future activity; the design is to be determined. DQOs and sampling to support future treatment may be required.)
- Perform VOC treatment and disposal of non-TRU drums
- Ship the packaged TRU material to WIPP.

2.2.1 Problem

Analytical data are needed to confirm acceptable knowledge information and assign characteristic RCRA hazardous waste numbers (i.e., waste codes) that apply to the waste.

Data is needed for safe and compliant onsite CERCLA storage of the drummed waste (e.g., to demonstrate compliance with the CERCLA storage area waste acceptance criteria).

Data is needed for certifying retrieved waste for shipment to WIPP.

2.2.2 Decisions

Retrieved waste meets the WIPP Waste Analysis Plan (WAP) (NMED 2004) definition of newly generated waste. For newly generated waste, the WAP requires that "the RCRA regulated constituents in newly generated waste will be documented at the time of generation based on AK for the waste stream." Initial determination of the RCRA regulated constituents will be accomplished as follows.

A preliminary hazardous waste determination (HWD) will be conducted to support initial assignment of hazardous waste numbers and onsite CERCLA waste management activities. The HWD

will be based on available process waste stream information (e.g., CERCLA inventory documentation, INEEL stored waste inventory AK, and buried waste AK documentation) and relevant analytical data from similar waste streams managed to date as part of the Waste Area Group (WAG) 7 CERCLA program (e.g., Glovebox Excavator Method Project waste streams).

Retrieved waste materials will be temporarily stored pending disposition in CERCLA storage areas. Data to support acceptance under the CERCLA storage area waste acceptance criteria (WAC) and applicable or relevant and appropriate requirements (ARARs) will be generated and entered into the Integrated Waste Tracking System. This data includes Pu-239 fissile gram equivalent (FGE), radiological measurements (dose rate & contamination levels), drum weight, and the date the drum is packaged - all linked to drum identification.

The hazardous waste codes determined by AK for each as-disposed waste forms will be summed and uniformly applied to the waste retrieved from the described area in Pit 4. This suite of hazardous waste codes will be confirmed by sampling and analysis. Objectives related to Toxic Substances Control Act regulations of "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions" (40 CFR 761) and WIPP are still being worked with CCP.

The newly packaged waste materials will be evaluated for potential transfer to WIPP. Payload containers (e.g., individual drums, standard waste boxes, and 10-drum overpacks) will be assembled for transfer to WIPP in TRUPACT-II containers. Payload containers that are certified to meet the WIPP waste acceptance criteria will be transported to WIPP for final disposition.

Retrieved waste materials that do not satisfy the WIPP waste acceptance criteria (e.g., non-TRU waste streams) will be characterized and evaluated for alternate disposal. Depending upon waste stream characteristics, treatment of these materials may be required to support achieving appropriate disposal standards required by ARARs and other health-based or facility-specific waste acceptance criteria. Other waste streams, which are not TRU waste, such as uranium roaster oxides, may require further analysis and treatment before disposal.

2.2.3 Decision Inputs

The following inputs are needed for the decisions in Section 2.2.2:

- Waste acceptance criteria for ARP storage enclosure for compliant interim storage
- Incorporation of acceptable knowledge documentation
- Visual examination data
- Resource Conservation and Recovery Act characteristic hazardous waste thresholds
- Drum assay, headspace gas data from the newly packaged waste
- Gas generation testing data.

2.2.4 Boundaries

The boundary of the WIPP RCRA characterization is the physical contents of the newly packaged drum population being characterized. The material to be sampled is the homogeneous solids and

soil/gravel. The boundary of measurements to demonstrate WAC compliance is the physical contents and related properties of the newly packaged drums.

2.2.5 Decision Rules

The following statements address the decision rules for targeted waste:

- For WIPP RCRA characterization, if the upper 90% confidence limit (UCL_{90}) of the mean concentration of any contaminant is found (through total concentration analyses [as opposed to leachable concentration]) to be greater than 20 times the toxic characteristic leaching procedure threshold (for which there has been no corresponding hazardous waste code applied by acceptable knowledge), then the decision rule would be to apply the appropriate characteristic waste code to the entire drum population.

- Drum radiological contact readings must meet approved WAC for ARP stored waste.

- If drum assay results are >380 FGE, then special storage conditions are required.

- Waste eligible for acceptance at WIPP must have TRU activity>100 nCi/g. Drums that are <100 nCi/g will be evaluated for suitable load manage criteria. Drums that meet the requirements for WIPP load management will be load managed with TRU waste. Drums that do not meet the criteria for load managing will be will remain in storage awaiting additional testing for final disposition.

2.2.6 Sampling Design and Associated Decision Error

The proposed sampling process to confirm the HWD for Pit 4 TRU waste occurs at the time of packaging and is presented in *CCP WIPP/RCRA Field Sampling and Analysis Plan for the Accelerated Retrieval Project for a Described Area within Pit 4* (CCP 2004). Samples will be sent to the Idaho Nuclear Technology and Engineering Center Analytical Laboratories Department for totals analysis using WIPP-certified procedures under the WIPP-approved INEEL TRU Waste Characterization Program (TWCP).

Decision error for radiological control measurements are managed by the Radiological Protection Manual and associated procedures.

Headspace gas generation testing and TRU assay of the drummed waste will be performed under WIPP-certified procedures under the WIPP

2.3 Nontargeted Waste that May Be Removed

It is possible that, during the process of excavation, other waste will be revealed that is not within the targeted waste streams. This nontargeted waste will also be removed from the excavation during this removal action if the DOE remedial project manager, the EPA, and Idaho DEQ WAG 7 remedial project managers agree that retrieval is warranted because the information concerning the nontargeted waste that is available from visual inspection (such as package labeling or distinctive packaging) identifies the nontargeted waste as being of a nature that (1) it poses a potential risk of contamination to the underlying aquifer if left in place, (2) the potential risk is sufficient to warrant removal at that time rather than leaving it to be addressed by the OU 7-13/14 final remedial action for WAG 7, and (3) the waste can

safely be managed by retrieval using the personnel, facilities, and equipment readily available onsite for retrieval of the targeted waste streams.

These materials will not be sampled under this DQO document; rather, a separate plan would be put in place.

2.4 Nontargeted Material that Stays in the Pit

An Agency meeting was held on July 19, 2004, and the DQO process was performed during the meeting to address public concerns regarding the visual segregation method for removing targeted TRU waste. Outputs from this process resulted in DQOs, which are statements that describe the following:

2.4.1 Problem Statement

Data does not currently exist to validate and improve the visual segregation method for targeting certain RFP TRU waste forms.

2.4.2 Decision Statement

The principal study question (PSQ) is:

What is the TRU activity and physical description of the materials that stay in the pit?

The PSQ gives the following decision statement: Determine the TRU activity and capture a physical description of the sampled materials which would have otherwise not been retrieved that affect visual criteria for future decisions. To address this decision, the project will collect and analyze samples for the target contaminants as identified in Table 1.

2.4.3 Decision Inputs

The following inputs are needed for the decisions in Section 2.4.2:

- List of radiological COCs for OU 7-13/14 based on the inventory records of the excavation area
- Assessment of radionuclide data from drum assays of targeted waste retrieved from Pit 4
- Visual characteristics of sampled materials which would have otherwise not been retrieved during Pit 4 excavation
- TRU assay of sampled materials which would have otherwise not been retrieved during Pit 4 excavation (not targeted)
- Radiological contact survey information from sampled non-target material (contact beta-gamma readings)
- Incorporation of acceptable knowledge documentation.

2.4.4 Study Boundaries

The spatial boundaries of concern for this study are confined to the physical contents of a described area within Pit 4 not targeted for retrieval. Material type is limited to nondebris soils and waste solids.

2.4.5 Decision Rule

The nondestructive drum assay data will provide information for future retrievals. There is no regulatory driver for this activity and action limits have not been specified. The goal is to confirm assumptions for visual identification of TRU waste forms for future retrievals.

Estimation of the activity remaining in the pit will be performed. The number of samples required for measuring the activity is determined using a chosen confidence level, coefficient of variation, and margin of error. The Agencies agreed to measure the activity remaining in the pit using the 90% confidence level, 1.0 coefficient of variation, and 20% margin of error. For these parameters, the number of samples required to estimate the activity remaining in the pit is 68.

2.4.6 Sampling Design and Associated Decision Error

The sample design chosen for this activity is based on addressing concerns to confirm expected activity levels in Pit 4 materials not targeted for removal/retrieval. The basic sampling strategy is to perform random sampling of materials remaining in the pit (not targeted for removal). Descriptions of the sampled non-targeted material will be recorded (any packaging present, physical characteristics), photographs of material may be collected, and drummed (TRU) assay data will be collected on non-targeted material. The FSP will provide the specifics of the sampling and analysis design and ensures that meaningful and accurate measurements are obtained that meet all quality assurance requirements. The drummed material may be shipped to WIPP as TRU waste, load-managed with other TRU-waste for shipment to WIPP, or alternately disposed of with other non-TRU (i.e., alpha LLW). If shipped to WIPP, the waste will undergo headspace gas analysis and GGT if indicated.

2.5 Underburden

Information was requested by the Agencies to confirm of the absence of VOCs and potentially mobile radiological COCs in the underburden. An Agency meeting was held on July 19, 2004, and the DQO process was performed during the meeting to address the request. Because sampling of the underburden is mainly a project requirement, there are no choice alternatives for some steps. Outputs from this meeting resulted in DQOs, which are statements that describe the following:

2.5.1 Problem Statement

Data is needed to evaluate the release of VOCs and OU 7-13/14 radiological COCs with a K_d of less than 8 to the underburden (such as technetium-99, iodine-129, uranium isotopes, carbon-14, chlorine-36, neptunium-237, and colloidal plutonium as represented by plutonium isotopes).

2.5.2 Decision Statement

The PSQ is:

- Are VOCs and potentially mobile COCs present in the underburden?

The PSQ gives the following decision statement: Determine the concentration of potentially mobile radiological COCs in the underburden. To address this decision, the project will collect and analyze samples for the OU 7-13/14 radiological COCs and VOCs as identified in Table 1.

2.5.3 Decision Inputs

The following inputs are needed for the decisions in Section 2.5.2:

- List of radiological COCs for OU 7-13/14 based on the inventory records of the excavation area
- Assessment of radionuclide data from drum assays of targeted waste retrieved from Pit 4
- Visual characteristics of waste above sample location
- Analytical data for VOCs and potentially mobile radionuclides of concern.

2.5.4 Study Boundaries

The spatial boundaries of concern for this study are confined to the physical contents of a described area within Pit 4 not targeted for retrieval. Physical limitations may preclude access and attaining an adequate volume for analysis.

2.5.5 Decision Rule

The information collected on VOCs and potentially mobile radionuclide COCs will be used in the ROD process.

2.5.6 Sampling Design and Associated Decision Error

The sampling is designed to confirm that VOCs and potentially mobile radionuclide COCs are not present in the underburden. The FSP will provide the specifics of the sampling and analysis design and ensures that meaningful and accurate measurements are obtained that meet all quality assurance requirements.

2.6 Large Objects and High Radiation Waste

Large objects encountered during excavation or items that cannot be size-reduced (i.e., broken up or sheared) or lifted safely using end-effectors deployable by the selected excavation equipment will be exempted from retrieval. Large objects will be identified by name based on acceptable knowledge. Unanticipated large objects (i.e., outliers) will be evaluated for relocation or removal but may be left in place if the retrieval equipment cannot perform the handling activities in a safe manner. A list of anticipated large objects within the described area of Pit appears in the excavation plan (Preussner et al 2004).

The presence of large objects in Pit 4 may affect future preparation for a surface barrier. The location of large objects left in the pit will be recorded for OU 7/13/14. Grid markings on the walls of the pit enclosure will identify the x,y coordinates. The z-coordinate will be collected using the depth indicator on the excavator and corresponds to a depth below the top of the waste zone.

During retrieval, high radiation waste could be encountered. If any highly radioactive (e.g. > 200 mR/hr) waste is encountered and left in place in the pit, the location in the pit will be recorded.

2.7 Waste Zone Material

The soils and waste solids described in this NTCRA are associated with significant acceptable knowledge documentation developed through OU 7-10 and OU 7-13/14 CERCLA activities and derived from the Transuranic Waste Program. Analytical data are needed to supplement existing acceptable knowledge to appropriately classify the retrieved waste under the Toxic Substances Control Act (TSCA) (15 USC § 2601 et seq.) for proper storage and disposal.

2.7.1 Problem

Analytical data are needed to supplement existing acceptable knowledge information and apply the appropriate classification of the drummed waste under TSCA.

2.7.2 Decisions

The principal study question (PSQ) is:

Are levels of PCBs present in the soils and waste solids at concentrations ≥50 ppm that would cause the waste to be regulated under TSCA?

The PSQ gives the following decision statement: Determine if the excavated material is regulated under the TSCA. To address this decision, the project will collect and analyze samples for the target contaminants as identified in Table 1.

2.7.3 Decision Inputs

The following inputs are needed for the determinations listed in Section 2.7.2:

- Incorporation of acceptable knowledge documentation
- Toxic Substances Control Act regulatory thresholds for PCBs
- OU 7-10 Glovebox Excavator Method data
- Analytical data from Pit 4 samples.

2.7.4 Study Boundaries

The spatial boundaries of concern for this study are confined to the physical contents of the waste zone layer in the 1/2 acre described area within Pit 4. A TSCA determination will be made for the first 1/4 acre. A separate determination will also be made for the second 1/4 acre. Material type is limited to nondebris waste because debris waste may be characterized using acceptable knowledge.

2.7.5 Decision Rule

The following statement addresses the decision rule for the soils and waste solids:

- If the UCL_{90} of the mean concentration indicates the presence of PCBs is ≥50 ppm, the decision rule is to designate the entire drum population as TSCA-regulated waste.

2.7.6 Sampling Design and Associated Decision Error

The sample design chosen for this activity is based on estimating the mean concentration of PCBs with respect to the regulatory threshold of <50 mg/kg. This is achieved with 90% confidence if the upper 90% confidence limit on the true mean is less than the regulatory threshold of 50 mg/kg. The PCB concentration will be measured for the waste layer in each 1/4-acre area in the pit using the 90% confidence level. For these parameters, 25 samples are required for each 1/4-acre area to estimate that the true mean is below the regulatory threshold.

The basic sampling strategy is to perform random sampling of the waste zone materials in the two 1/4 acres of the described area within Pit 4. The proposed sampling will take advantage of the random sampling scheme already proposed for the WIPP characterization of each 1/4 acre of the described area within Pit 4. Sample collection for PCB determination can occur after the sampling process for WIPP is completed for the identified sample tray.

The FSP will provide the specifics of the sampling and analysis design and ensures that meaningful and accurate measurements are obtained that meet all quality assurance requirements.

2.7.6.1 Calculation of Sample Size. Since we are basing the decision on a standard confidence limit, we have to assume that the data are normally distributed. Additionally, the sample size formula is based on a t-statistic, which also assumes normality.

The necessary sample size was estimated using the composite sample PCB data from the OU 7-10 Glovebox Excavator Method Project. Data that were reported as less than the method detection limit were assumed to be not representative of what is expected in Pit 4; therefore, only 57 sample results above the method detection limit were considered.

The Shapiro-Wilk W statistic is used to assess normality. For the data in original units, the W statistic is 0.686 with a p-value of <0.0001. This very strongly indicates a departure from normality. In an attempt to achieve normality, the data were transformed using natural logarithms and the Shapiro-Wilk test was repeated. For the transformed data, the W statistic is 0.975 with a p-value of 0.282. This indicates that the assumption of normality has been met. Therefore, the individual measurements and the regulatory threshold should be log-transformed before calculation of the sample size.

Sample size is calculated using the following formula:

$$n = \frac{t^2_{1-\alpha, n_0-1} s^2}{(\overline{\times} - RT)^2}$$

where

n_0 = the initial number of samples used to calculate the preliminary sample estimate

n = the calculated number of samples in the preliminary estimate

s^2 = calculated concentration variance

t^2 = the 90th percentile for a t distribution with n_0-1 degrees of freedom

RT = Regulatory Threshold of the contaminant (toxicity limit for toxicity characteristic wastes, program-required quantitation limit for listed wastes).

The 57 OU 7-10 sample results used for the sample size calculation are actually from composite samples with 10 aliquots per composite. The variance, s^2, is the variance of individual measurements, not the variance of composites and must therefore be multiplied by the number of aliquots making up a composite, or 10.

The summary statistics, in the log-transformed state, consist of a mean of 2.61 and a variance of 2.39. The natural log of the regulatory threshold is 3.91. The t-value associated with 90% confidence is iterative based on the calculated sample size. The calculation of the sample size is then:

$$n = \frac{(1.318)^2 (10)(2.39)}{(2.61 - 3.91)^2} = 25$$

2.8 Assumptions

A number of assumptions are associated with the characterization approach developed in this document. The assumptions bound the evaluation performed. If project scope and requirements invalidate the assumptions, reevaluation of the characterization approach is required. The current project approach makes the following assumptions:

- The inventory of waste and chemicals to be excavated is represented accurately by those presented in the *Ancillary Basis for Risk Analysis* (Holdren et al. 2002)
- Project applicable or relevant and appropriate requirements are limited to those identified in Appendix A of the *Engineering Evaluation/Cost Analysis for the Accelerated Retrieval of a Designated Portion of Pit 4* (DOE-ID 2004a)
- Visual examination and inventory basis documentation is adequate to characterize waste for items prohibited in the "Radioactive Waste Management Manual" (DOE Manual 435.1-1)
- Fissile material loading limits in the Criticality Safety Program requirements document (PRD-112)
- Hazardous waste codes will be applied to the retrieved waste for compliant storage
- Polychlorinated biphenyls may be present above the regulatory threshold in the waste zone material, and the project will confirm through the analytical characterization process whether or not the drummed waste zone material is regulated under TSCA.

3. DATA QUALITY OBJECTIVES

The characterization approach presented in Table 1 relies on physical sampling, visual evaluation, nondestructive assay, acceptable knowledge, and process knowledge (i.e., inventory basis) to accomplish the data objectives. The objectives and associated characterization approach satisfy the characterization requirements of the following:

- Applicable or relevant and appropriate requirements (including chemical compatibility considerations)
- "Radioactive Waste Management" (DOE Order 435.1)
- Fissile material loading limits in the Criticality Safety Program Requirements Manual (PRD-112).

3.1 Data Quality Objectives Table

This section contains information about the DQOs presented in Table 1.

3.1.1 Objective

The DQO description appears in the Objective column.

3.1.2 Data Usage

Entries in this column discuss how data will be used.

3.1.3 Measurements

Measurements are taken to answer DQO data needs. Numbering of specific measurements for a given DQO is maintained across all columns for that DQO. For example, Item 4 in columns labeled Sampling Method, Analytical Method, or Required Detection Limit, refers to Measurement 4 in the Measurement column.

3.1.4 Sampling Method

Sampling method information indicates what kind of samples will be collected for analytical measurements. Visual methods also are listed as sampling methods. These methods primarily focus on identifying visual cues that would require collection of biased samples.

3.1.5 Analytical Method

Analytical methods have been identified to meet the required detection level (sensitivity of measurement) to satisfy the DQO. Visual methods are specified for several DQOs in the analytical method column. These methods primarily focus on the identification of visual cues. Analytical methods appearing with an identification of SW-846 are taken from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1996).

3.1.6 Analytical Level

Two types of analytical levels appear in this column, as listed below:

- **Definitive—**Definitive data are generated using rigorous analytical methods (e.g., approved EPA methods or well-established and documented test methods). Data are analyte-specific with confirmation of analyte identity and concentration. Methods produce tangible raw data and satisfy rigorous quality assurance and quality control requirements. For the data to be definitive, either analytical or total measurement error must be determined.

- **Screening—**Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Screening data provide analyte or property identification and quantification, though the quantification may be imprecise.

3.1.7 Required Detection Levels

Required detection limits specified in the DQO tables refer to project-specific performance or attainment levels identified for corresponding analytical methods. These detection limits have been identified as a basis for selecting analytical equipment and methods. In general, limits were identified using the following criteria:

- Relevance to data objectives and expected Project conditions

- Guidance provided in the approved WAC for ARP stored waste

- Guidance provided by the WIPP WAP (NMED 2004)

- Attainable, with margin, using commercial-off-the-shelf equipment

- Achievable without introduction of additional project risk.

Detection levels (i.e., radionuclides in the underburden) in Table 1 are listed in accordance with the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10 and Deactivation, Decontamination, and Decommissioning* (QAPjP) (DOE-ID 2004b), indicating that the detection limits for the target compounds are requested in accordance with the requirements in the QAPjP.

3.1.8 Comments and Rationale

Information and comments are added to clarify sampling approaches, explain the basis for the measurements required, and provide information pertinent to the DQO.

Table 1. Data quality objectives for the Accelerated Retrieval Project.

Objective	Data Use	Measurement	Sampling Method	Analytical Method	Analytical Level	Required Detection Level	Comments and Rationale
Ensure safe storage of retrieved waste	Collect sufficient information to support safe storage per approved WAC for ARP stored waste and for future disposition	1. Compatibility of hazardous materials 2. Volume in new package 3. Pu-239 FGE. 4. Weight of container 5. Radiological dose rate requirements for container disposal 6. Hazardous waste determination 7. PCBs	1. NA. 2. Visual at closure of container. 3. Fissile material monitoring. 4. NA 5. 100% container radiological survey 6. NA 7. Location-based random sampling	1. Acceptable Knowledge 2. Visual 3. Fissile material monitor. 4. Weigh drum 5. Radiological survey 6. HWD will be made based on available process waste stream information 7. SW-846 Method 8082[a]	Definitive, Screening, Health Physics Survey	1. NA 2. Nearest 1/8 drum 3. Monitor capability specification is for minimum detectable activity of 1 g Pu-239 FGE (using a 5-minute count time) 4. NA 5. Based on disposal facility requirements 6. NA 7. Per procedure	1. Acceptable knowledge is the inventory basis and documented evaluation of compatibility of a binary combination of chemicals. 3. If drum assay results are >200 FGE, then special storage conditions are required. Density estimate to be calculated from noted weight and volume measurements. 7. Samples will be taken in the first 1/4 acre to make the TSCA determination for drums that originate from that 1/4 acre. A separate, identical determination for the second 1/4 acre will also be made.
Characterize waste for shipment to WIPP	Provide data on newly generated waste to confirm AK and for future disposition.	1. Visual examination 2. Total metals 3. VOCs 4. Semivolatile organic compounds 5. a. Transuranic activity (i.e., nCi/g) b. Pu-239 equivalent activity (i.e., PE-Ci) c. Pu-239 FGE d. Uranium isotopic masses (U-233, U-234, and U-238) e. Plutonium isotopic masses (Pu-238, Pu-239, Pu-240, and Pu-242) f. Am-241 mass g. Total fissile mass (U-233, U-235, and Pu-239) h. Nonfissile beta-gamma emitting radionuclides (Sr-90 and Cs-137). 6. Headspace gas 7. GGT 8. Contact dose rate (beta+gamma+neutron) at container surface 9. Dose rate (gamma/neutron) dose rate at 1 m container surface 10. Neutron contribution (at contact) Container surface smearable alpha/beta contamination	1. Visual 2–4. Sample collection strategy is detailed in the WIPP/RCRA FSP text. Please reference text in the CCP WIPP/RCRA FSP[c]. 5. 100% drum assay will provide TRU characterization in conjunction with acceptable knowledge. 6. SUMA canister 7. Generation rate of hydrogen, methane, or total gas in a waste container. 8-11. 100% container radiological survey	1. Visual 2. ACMM[b]-8909, ACMM-2901, ACMM-2810, 3. ACMM-9260, ACMM-9441 4. ACMM-9270 ACMM-9500 5. Nondestructive assay 6. ACMM-9930 7. WIPP approved procedure 8-11. Radiological survey	Definitive, Health Physics Survey	1. per WIPP approved procedure 2. per WIPP approved procedure 3. per WIPP approved procedure 4. per WIPP approved procedure 5. per WIPP approved procedure (As achievable with current technology). 6. per WIPP approved procedure 7. per WIPP approved procedure 8. 0.5 mRem/hour 9. 0.5 mRem/hour 10. 0.5 mRem/hour 11. 200 dpm/100 cm^3 beta-gamma, or 20 dpm/100 cm^3 alpha	1. Visual examination WIPP-prohibited items is performed by CCP 2-4. Sampling is performed by CCP. Analysis of the samples is performed for all WIPP required target analytes per WIPP approved procedures under the requirements of the INEEL TWCP 5. TRU determination is made of the drum contents by CCP 6. Headspace gas sampling is performed by CCP. Analysis of the samples is performed for all WIPP required target analytes per WIPP approved procedures under the requirements of the INEEL TWCP 7. GGT is performed by CCP.
Provide data on material that stays in the pit (sampled materials which would have otherwise not been retrieved)	Verify efficiency of visual criteria for future decisions	1. Visual description 2. a. Transuranic activity (i.e., Ci) b. Pu-239 equivalent activity (i.e., PE-Ci) c. Pu-239 FGE d. Uranium isotopic masses (U-233, U-234, and U-238) e. Plutonium isotopic masses (Pu-238, Pu-239, Pu-240, and Pu-242) f. Am-241 mass g. Total fissile mass (U-233, U-235, and Pu-239) h. Nonfissile beta-gamma emitting radionuclides (Sr-90 and Cs-137).	1. Visual 2. 100% drum assay will provide TRU characterization	1. a. Detailed description of material b. photograph of material 2. Nondestructive assay	Definitive, Screening	1. NA 2. per WIPP approved procedure (As achievable with current technology).	1. Descriptions of the non-targeted material will be recorded (any packaging present, physical characteristics. Visual examination WIPP-prohibited items is performed by CCP 2. TRU determination is made of the drum contents by CCP

Table 1. (continued).

Objective	Data Use	Measurement	Sampling Method	Analytical Method	Analytical Level	Required Detection Level	Comments and Rationale
Provide data on large objects and high radiation waste left in the pit	Provide data on large objects or high radiation waste that might affect remedies applied	1. Record locations of large objects or high radiation waste left in the pit. 2. Record a description of the object or waste.	1. Visual, using reference markers and electronic measure for depth. 2. Visual.	1. Grid markings on the walls of the pit enclosure will identify the x,y coordinates. The z-coordinate corresponds to a depth below the top of the waste zone 2. Visual description.	Screening	1. NA 2. NA	Large objects will be identified by name based on acceptable knowledge.
Provide characterization data for potentially mobile radiological OU 7-13/14 COCs and VOCs in the underburden	Characterize underburden soil to evaluate release of potentially mobile radiological OU 7-13/14 COCs and VOCs.	1. Technetium-99 2. Iodine-129 3. Carbon-14 4. Chlorine-36 5. Plutonium isotopes (Pu-238, and 239/240) 6. Neptunium-237 7. Uranium isotopes (U-233/234, U-235/236, U-238) 8. VOCs	The draft project FSP will define sampling details. Conceptual approach involves collection of underburden soil from exposed underburden area using the excavator.	1. Liquid scintillation or equivalent counting method. 2. Low energy photon spectrometry or equivalent counting method. 3. Liquid scintillation or equivalent counting method. 4. Liquid scintillation or equivalent counting method. 5-7. Alpha spectroscopy. 8. SW-846 Method 8260B[e]	Definitive	1. 1 pCi/g in accordance with QAPjP[d] 2. 1 pCi/g in accordance with QAPjP[d] 3. 3 pCi/g in accordance with QAPjP[d] 4. 10 pCi/g 5-7. 0.05 pCi/g in accordance with QAPjP[d] 8. Per procedure	Based on project objectives, underburden is not excavated but is exposed to allow sampling for VOCs and potentially mobile radionuclide COCs.
Monitor and record facility emissions and worker exposure.	Startup and operation authorization and assessing short-term risk information.	1. Facility air emissions in accordance with the "National Emission Standards for Hazardous Air Pollutants Radiological Monitoring Plan for the Accelerated Retrieval Project".[f] 2. Air-monitoring measurements from the HASP[g] 3. Worker radiological monitoring records in accordance with the HASP.[g]				1-3. In accordance with referenced plans.	1-3. Does not impose or imply additional measurement requirements beyond what is required by safety and environmental regulations.

a. EPA 1996
b. ACMM methods are based on "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, (EPA 1996).
bc. CCP, 2004, *WIPP/RCRA Field Sampling and Analysis Plan for the Accelerated Retrieval Project for a Described Area within Pit 4*, CCP-PO-025, Revision 0 Draft D, Central Characterization Project, U.S. Department of Energy Carlsbad Field Office.
d. DOE-ID 2004b
e. EPA 1996
f. Banaee 2004
g Wooley 2004
AK = acceptable knowledge
ARP = Accelerated Retrieval Project
CCP = Central Characterization Project
COC = contaminant of concern
FGE = fissile gram equivalent
FSP = field sampling plan
HASP = health and safety plan
HWD = hazardous waste determination
NA = not applicable
QAPjP = quality assurance project plan
PCBs = polychlorinated biphenyls
PE = Pu-239 equivalent activity
TSCA = Toxic Substances Control Act
RCRA = Resource Conservation and Recovery Act
TWCP = TRU Waste Characterization Program
VOC = volatile organic compound
WAC = waste acceptance criteria
WIPP = Waste Isolation Pilot Plant

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